

Name:

## Math 115 Exam 3

March 14, 2019

1. WRITE YOUR NAME ON THIS TEST!
2. Except where indicated, merely finding the answer to a problem is not enough to receive full credit; you must show how you arrived at that answer.
3. Unless indicated, DO NOT convert irrational numbers such as  $\sqrt{3}$  or  $\pi$  into decimal approximations; just leave them as they are.
4. If you have a question, raise your hand or come up and ask me.

**1)** (8 points) Draw the graph of a SINGLE function  $f$  that is defined on the interval  $[-3, 5]$  such that ALL of the following conditions are satisfied:

- (i)  $f$  has an absolute minimum at  $x = -2$ ,
- (ii)  $f'(0) = 0$  but  $f$  has neither a local maximum nor a local minimum at  $x = 0$ , and
- (iii)  $f$  has both a local and an absolute maximum at  $x = \pi$ .

**2)** (17 points) The position of a Higgs Boson in CERN's Large Hadron Collider is given in meters by  $s(t) = 2t^3 - 9t^2 - 60t + \pi$  where  $t \geq 0$  is in seconds.

a) (9 points) Locate all critical points of  $s(t)$ .

b) (6 points) Find the intervals where the boson is moving forward (increasing) or moving backward (decreasing).

c) (2 points) Determine the local maxima and minima (if any exist) of  $s$ .

**3)** (18 points) Find the equation of the tangent line to the graph of

$$xy^3 - yx^3 = \sin(\pi(x - y))$$

at the point  $(\pi, \pi)$ .

4) (17 points) Find the absolute maximum and minimum for the function  $f(x) = \sin(x^2) + \cos(x^2)$  on the interval  $[-\sqrt{\pi/6}, \sqrt{2\pi/3}]$ .

**BONUS:** (10 points) Show that  $\tan(x) > x$  for all  $x$  in the interval  $[\pi/4, \pi/2)$ .  
A picture of the graph from your calculator will get you zero points.